A METHOD FOR IMPLEMENTING QP-4, AN AIR FORCE LOGISTICS COMMAND QUALITY ASSURANCE PROGRAM, IN A BASE LEVEL AIRCRAFT MAINTENANCE ORGANIZATION

THESIS

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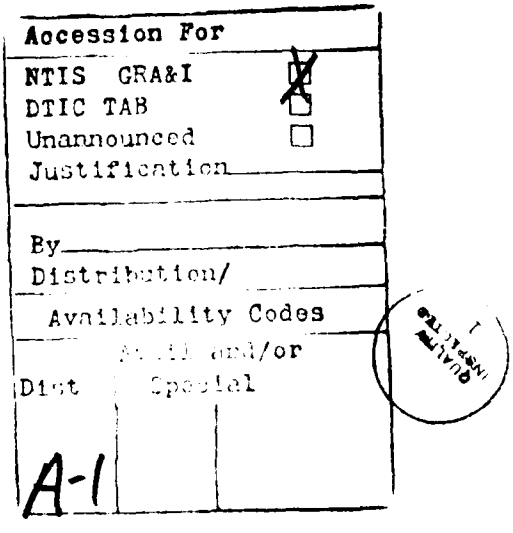

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Presented to the School of Systems and Logistics
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in Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

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Preface

The purpose of this study was to recommend an implementation plan for QP-4 in base level aircraft maintenance organizations. The need for such a plan came about from a realization of expanding mission requirements and decreasing resource availability, specifically in the aircraft maintenance field, but the recommendations may offer potential benefits to many other career fields as well.

While conducting this research and writing this thesis, I've become indebted to many others. In particular I'd like to thank my thesis advisor, Lt Col Christensen and my reader, Lt Col Lindsey for their help in refining my strategy and following through with my objectives. Also warranting my appreciation was the Quality Programs Office at Warner Robins Air Logistics Center for supplying scores of documentation and background information on quality and QP-4. Finally, I'd like to thank my wife Ann for her unblinking support and assistance throughout this endeavor.

Michael E. Farmer

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beneficial to field managers for meeting these future challenges. The recommendations include beginning quality and QP-4 training in the Aircraft Maintenance Officers Course (AMOC) with specific topic coverage recommendations. Also recommended was the systematic implementation of QP-4 in the base organizations by using a three phased implementation plan. First introduce and publicize, then educate and train, and finally implement and structure basically in line with the program operating at Warner Robins. In closing, the study recommended areas of related research that may further support or build on this initial endeavor.

Abstract

The purpose of this study was to recommend a method for implementing QP-4, an Air Force Logistics Command Quality Assurance program, in a base level aircraft maintenance organization. There were three objectives related to this study. The first was to provide aircraft maintenance managers with a means to identify the quality management needs in the field. Second was to familiarize maintenance managers with state of the art knowledge concerning the definition of quality, how to measure it, and what comprises a quality assurance program under QP-4. The final objective was to showcase the QP-4 program currently functioning and meeting a good deal of success at the Warner Robins Air Logistics Center.

Accomplishing these objectives resulted in a plan to implement QP-4 in a base level organization so that field managers could effectively deal with projected expanding mission requirements along with reductions in resource availability due to budget limitations in a constrained financial future operating environment.

Examination of industrial case studies and results of QP-4 implementation at Warner Robins led to the conclusion that the simplicity and versatility of QP-4 would be

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I. Introduction

Background

The decade of the 80's brought many new and interesting changes to the way organizations operate. From telecommunications and information processing to computer operated machine tools and artificial intelligence, the production environment is more advanced than ever before in history. Much has been written in the last ten years about new methods for improving effectiveness, reducing costs, and the need to set clearly stated goals that are difficult to achieve. Much of the literature about the new production environment is especially relevant to organizations involved in manufacturing or maintenance activities. Improving quality is the cornerstone for many of these actions. And in today's ever increasingly competitive and complex environment, "The challenge to constantly improve quality has never been greater" (20:2).

A common element of organizations which have successfully implemented quality initiatives seems to be a top to bottom 'cultural change'. This change reflects an adaptation whereby quality becomes everyone's responsibility (11:8). For the Department of Defense (DoD) and more specifically the United States Air Force (USAF), ". . . logistics shortfalls, even apparently minor support deficiencies, can easily have calamitous impacts on today's complex and sophisticated weapon systems -- and on the combat forces relying on them" (11:1). For this reason,

> . . . the bottom line for future viability of our Air Force as a war fighting organization depends, in a large measure on our ability to inject, in a disciplined way the concerns, controls, and capabilities necessary to put quality into all of our logistics processes. (11:2)

Quality, and how employees can achieve it, is one field of study typified by this large infusion of new ideas and writings. In recent years, "the art and science of achieving quality through people has advanced dramatically" (22:28). An extensive list of scholars, experts, and practitioners published an enormous volume of research and described experiences directed at identifying philosophies, approaches and incentives for organizations to devote increased energies toward improving their quality efforts.

The following chapters summarize the foundation of that knowledge, highlight the need to act with patience and consistency, and then examine one method currently used in

depot level logistics activities that is proposed to meet similar challenges in the base level aircraft maintenance community. The method being proposed is entitled QP-4 and was developed by the Air Force Logistics Command, a leader in the DoD quality effort. QP-4 synthesized many of the current quality improvement philosophies into a practical, simple, and versatile framework that appears to have tremendous potential for implementation across a wide variety of organizations.

Justification

In addition to the important impact on mission requirements, modern political forces imposed a financial requirement for the DoD to improve quality. An examination of the state of national affairs over the past four to five years showed annual deficits exceeding 200 billion dollars with both public and congressional concern over those amounts at extraordinarily high levels (2:14). These concerns directly led to the passing of the Gramm Rudman Hollings Act, which legislated both immediate and graduated deficit reduction requirements along with stipulations for automatic, across the board budget cuts in the event of failure to meet deficit targets.

Of the over 1,024 billion dollars in outlays from the Reagan fiscal 1988 budget, the administration labeled over

75 percent relatively uncontrollable. Relatively uncontrollable items, in this context, refers to outlays resulting from prior commitments of the federal government. These include ". . . previously granted budget authority, entitlements, open-ended programs that automatically rise with the economy, and permanent appropriations such as interest on the national debt" (2:6). The largest single area that can be 'controlled' and therefore will likely be manipulated to meet deficit targets is defense spending.

Therefore, the Gramm Rudman Hollings Act can be expected to significantly affect the availability of resources in tomorrow's defense appropriations. Compounding this effect, is the fact that the current fleets of weapon systems in Air Force inventories today are aging and will require increasing amounts of logistics support. This situation led Major General Gillis to observe that the Defense Department is being asked to do more, but at the same time being given less money to perform the expanded mission. General Gillis pointed out that,

> . . . the DoD budget left no room for scrap, rework or other deficiencies that flow from poor quality. For this reason, he said it was imperative that the entire DoD, along with its contractors and vendors, focus on quality as the vehicle for achieving higher levels of performance. (23:foreword)

Continuous quality improvements yield tremendous opportunity to maximize the use of available resources. "Improving quality and reducing cost can be done

simultaneously; . . . it means less scrap and rework and fewer field failures" (14:1). This translates to less waste of costly materials, doing things right the first time, decreased actual frequency of failures, and extended serviceable lifetimes of expensive equipment and weapon systems.

These benefits cannot be achieved overnight or by the pronouncement of a new policy. The timetable necessary to institutionalize the required cultural changes and give the necessary training to the appropriate employees may require as long as 10 years before an organization realizes any substantive benefits (6:62). With this horizon in mind, managers must be patient and consistent when developing quality strategies and making the decisions to begin implementing the strategies.

The Quality Programs office at Robins Air Logistics Center identified ten reasons why improvements in quality, through a program like QP-4, are needed in today's Air Force. They were:

1. To meet the President's goal of a 20 percent increase in productivity by the year 1990 as per Executive Order 12552.

2. To strengthen the Air Force internally making it better partners with industry, Congress, and the public.

3. To provide effective weapon system logistic support in spite of budget cuts.

4. To provide a structured way to review logistics processes in order to improve and establish controls for them.

5. To provide combat strength through quality logistics by maintaining a quality equipped and quality supported customer in the field.

6. To create a climate where every individual can contribute to upgrading our quality efforts.

7. To change the emphasis from inspecting at the end of the line to designing and building quality into the products.

8. To integrate quality initiatives within every organization with proper training at each level.

9. To distribute responsibility between management and the workforce proportionately.

10. To recognize and reward the competent, dedicated workers who make substantial contributions to quality initiatives. (23:5)

Problem Statement

Despite the efforts of the many dedicated professionals in the aircraft maintenance organizations of the Air Force and their supporting agencies, there does not appear to be an integrated quality program sufficient to meet logistical mission requirements under impending budget cuts. In the financially constrained future, aircraft maintenance managers must explore and implement quality improvement techniques in a proactive manner else they may not be able to successfully meet expanding future demands for supporting strategic nuclear deterrence. QP-4 has to date only been applied to depot repair facilities. The problem is how to

best apply QP-4 techniques to quality problems in base level aircraft maintenance organizations because it appears adopting a QP-4 program would be beneficial for meeting future mission requirements. The next section provides more details about the implementation of AFLC's QP-4 program for aircraft maintenance squadrons throughout the USAF.

Statement of Purpose and Objectives

The primary purpose of studying quality issues and QP-4 was to provide educated recommendations for incorporating quality initiatives in the aircraft maintenance at both the Air Force and base levels. There were three objectives related to this study. The first objective is to provide aircraft maintenance managers and their career planners with a means to identify the quality management needs in the field. The second objective is to familiarize maintenance managers with state of the art knowledge concerning the definition of quality, how to measure it, and what comprises a quality assurance program under QP-4. The third objective is to showcase the QP-4 program currently functioning and meeting with a good deal of success at the Warner Robins Air Logistics Center.

Assumption

To make the application to base level maintenance activities, one relevant assumption was necessary. It was assumed that the majority of Air Force maintenance managers have neither classroom training nor practical experience in modern quality improvement techniques in an industrial production environment prior to entering the service. This assumption is relevant because some of the basic components of a QP-4 program are providing classroom training and building practical experience using quality improvement techniques. If these needs were already met to a large degree, the QP-4 program activities for a base level maintenance organization would be substantially different. With this assumption established, the range of applicability will now be addressed.

Scope

This research was not intended to apply to all organizations in all environments. Rather, the results should apply to a majority of aircraft maintenance organizations in the USAF. The principles and methods of QP-4 have been field demonstrated to be applicable to the industrial production and repair environment such as those encountered in AFLC's aircraft maintenance facilities. Similar to those in AFLC, aircraft maintenance activities at

the base level include a wide range of scheduled and recurring inspection and maintenance requirements. In contrast, the base level maintenance charter includes handling daily unprogrammed repairs resulting from inflight failures experienced from the wing's regular flying schedule and a primarily military workforce as opposed to AFLC's mostly civilian workforce makeup. The source of these requirements and the makeup of the workforce, however, should not affect the applicability of QP-4 methods for improving the underlying processes.

Expert opinion and fact were drawn together to form a framework of knowledge and a basic understanding of QP-4's focus so that managers can develop appropriate actions which meet the specific goals and needs of their organizations. The recommended implementation plan applied to managers in the field with a direct responsibility for the production effort. The primary goal was not an attempt to describe a universal approach that adapted to functions of related agencies such as engineering, design, scheduling, acquisition, staff, or clerical operations. Similarly, the objective was not intended to concentrate on formulae, statistical exercises, or sampling plans that only true statisticians could understand. Instead, the objective was to use research and education to build the maintenance manager's fundamental understanding of quality and begin the

process of cultural change necessary for survival in the future. The next section lists the investigative questions that will lead to the determination of how to best apply the techniques of QP-4 to the base level maintenance organization.

Investigative Questions

Two investigative questions will be answered:

1. How thoroughly does the Air Force train its incoming maintenance managers in quality improvement techniques. This raises a series of other questions:

   a. How full is the range of quality topics covered?

   b. To what depth is each topic covered?

   c. How are practical applications demonstrated?

   d. To what extent are maintenance managers who complete the Aircraft Maintenance Officer Course (AMOC) prepared to direct the quality management of an operational unit?

2. How can QP-4 be implemented to improve quality in base level aircraft maintenance?

Chapter Summary

This first chapter has introduced the idea of quality improvement for USAF base level aircraft maintenance

managers. It provided a description of both the financial environment and the expanding mission requirements facing the current and future military organizations and suggested some reasons why quality improvement was both useful and urgently needed. This chapter identified the specific problem as the need to implement QP-4 in base level aircraft maintenance organizations and provided a statement of purpose and objectives to culminate in recommendations for Air Force action. Based on the one relevant assumption, the range of applicability has been outlined, followed by a listing of the specific investigative questions to be answered.

Chapter II summarizes pertinent literature on quality published by quality experts in the past 5-10 years. Chapter III explains the methodology used to answer the investigative questions given in the first chapter. Chapter IV examines five successful applications of QP-4 in depot level facilities and the quality curriculum included in the Aircraft Maintenance Officers Course (AMOC). The examinations comprising Chapter IV, along with the background of knowlege about quality found through the literature review, culminate in Chapter V's recommended implementation plan for QP-4 in base level aircraft maintenance organizations.

II. Literature Review

Introduction

This chapter reviewed literature published on the topic of quality. Three primary areas were examined: methods of defining and measuring quality for use in quality assurance programs; an overview of two successful case studies using quality improvement programs with emphasis on program features and actual benefits realized; and finally, an examination of the AFLC quality improvement program, QP-4.

Quality: What is it?

The American Society of Quality Control (ASQC) has defined quality as the "totality of features and characteristics of a product or service that bear on its ability to satisfy a user's given needs" (15:176). Their definition included two key elements. The first element was the notion that no one factor is the essence of quality and the second element was that the user's needs are pivotal determinants.

A similar definition was put forward by Feigenbaum in his 1983 book Total Quality Control, where he defined product and service quality as:

> . . . the total composite product and service characteristics of marketing, engineering, manufacture and maintenance through which the product or service in use met the expectations of the customer. (9:7)

Note how Feigenbaum's definition also included the two essential factors from ASQC's definition.

Perhaps Juran has provided the most basic definition of quality. He observed the following relationship to be true of any organization: "The basic mission of any organization is to supply goods and services to meet the needs of users" (14:B-1). The basic mission of satisfying the needs of users led to his definition: "Quality means fitness for use" (14:B-1). This definition is simple enough to be meaningful but general enough to be used across a myriad of applications. Juran added the assumption that a product which conformed to specifications is also fit for use. If this is true, "the quality mission of many organizational departments is really one of conformance to specification" (14:B-1,B-2).

Deming added a functional aspect to quality by saying that quality is achieved by focusing on improving the process not by focusing on the product (5:25). His statement added a new dimension to the earlier definitions of quality. Crosby restated Juran's earlier contention with his sentiment that quality is conformance to requirements, but he added that quality is "getting people to do better the things they ought to be doing anyway" (4:3,17).

Others have offered definitions that restate or expand on the above. In 1987, Jaraidi argued that "the main component of product quality is accurate production" (13:50). This view represented the traditional approach and reflected only the production department's perspective of the issue. Kackar offered a more contemporary view of the issue in terms of the relationship between quality, variations and user's needs. His definition asserted that the smaller the performance variation around the target value, the better the quality. For the purposes of this definition, the target value was the ideal state of the performance characteristics from the user's point of view. The performance variation was the amount by which a product's performance deviates from its target value during the life span of the product under different operating conditions (15:177). Jack Wires, the vice president for quality assurance at Boeing Aircraft Corporation, echoed the mainstream of current thought when he defined quality as providing customers with products and services that consistently meet their needs and expectations (17:17).

Enrick provided a useful definition of reliability, a closely related and important dimension of quality. He stated that reliability is "the probability that a product, device or piece of equipment will give failure-free performance of its intended functions for the required

duration of time" (8:219). Each of these definitions offered further insight into the complete nature of just what determines the definition of quality. The basic consensus and the definition this study used was that quality is determined by everything that affects performance requirements as set by the customer. A corrolary to this definition would be that the closer a product comes to meeting each of these performance requirements and the smaller the variation around the targets, the better the quality. These relationships stated, the focus can turn to the measurement of quality.

Quality: Can it be measured?

Measuring quality is no simple task. As can be seen from the assorted definitions of quality, the term itself varied in meaning from user to user. Squires, in his book Successful Quality Management, pointed out that "quantity, cost and quality were undeniably linked" (18:16). Squire's observation implied that to be complete, any measurement method should recognize the simultaneous impacts on all three of these important areas.

Crosby offered a simple, yet elegant way of measuring quality and its costs. He suggested that quality should be measured by the cost of doing things wrong. For example, if a department performed tasks erroneously and wasted 1000

dollars worth of materials, that was a measure of the quality costs. Measuring the aggregate of similar costs throughout an organization will ostensibly determine the measurement of the overall quality costs. Through this argument, he coined the phrase and entitled his book, Quality is Free. His implication was that you don't pay for having quality, you pay for not having quality (4:17).

John Heldt, in his book Quality Pays, expounded on different areas typically associated with the cost of quality. His list included the costs incurred from prevention, appraisal, scrap, rework, and failure. He categorized failures into two groups, internal and external. The internal failures were scrap and rework, while the external failures were any failure found in the field. He stressed that the quality costs these failures generate are "true 100 percent wastes, which, with vigorous pursuit and intelligent effort, can be significantly reduced or eliminated" (12:26). Juran underscored this statement by charging that improving quality and reducing costs can be done simultaneously. "Better quality should therefore result in less scrap, less rework and less field failures" (14:Ja-1).

Inspections have been a favored method for measuring quality. Juran asserted that the two most prevalent purposes of inspection were "to judge product conformance

and to provide feedback data on quality to the producers" (14:G-1). It may be more insightful for this discussion, to look at what Juran did not say as opposed to what he did say. He did not say that inspection ensured or guaranteed quality. For example, Enrick observed that even a 100 percent inspection did not guarantee a perfect product (8:3). To the contrary, he noticed that it usually took a 200 percent inspection regimen to come close to guaranteeing a perfect product (8:3).

Coplan, the author of The Quality System, saw the purpose of inspection in a slightly different light. He felt inspection should be used for three purposes. First, inspection can assure management that adequate preventive measures have been taken to obtain satisfactory quality results. Second, inspection can prevent work from being invested in already nonconforming parts. A third purpose of inspection is to provide a means to minimize the likelihood of customer dissatisfaction. Similarly, he recognized the need for an 'audit' that identified system weaknesses and improper practices for ultimate correction ". . . through the regular comparison of products and processes with pre-established requirements and standards" (1:48).

Coplan highlighted the need for all departments in an organization to measure their progress towards whatever quality goals they have established each year (1:52). In

doing so, managers and workers alike stay apprised of the results of their actions and are reinforced accordingly.

Enrick pointed out that when processes and operations require close surveillance of quality during production, process inspection was best accomplished with the aid of a control chart. A control chart is a graphical representation of results, usually with respect to an upper and lower control limit. Enrick explained that the purpose of a control chart was "to show trends in the characteristics of a product and to provide a way to anticipate and correct whatever may be responsible for defective products" (8:45). Another tool he suggested to measure quality was a range chart. He professed that the range chart, a specialized form of a control chart which depicts the range a certain variable value takes on, can be used "to locate and eliminate the major sources of variability in a product" (8:65).

Each of these insights to the various methods of measuring quality and its associated costs were necessarily general in nature. The principles involved must be incorporated into actual applications before any specificity can be utilized. Crosby made the point that all the emphasis on quality measurement is actually of limited value when considered in the following context: "Why spend all this time finding, fixing and fighting when you could

prevent the incident in the first place?" (4:4). Feigenbaum echoed these sentiments by explaining that "quality must be designed and built into a product, because there is no way to exhort or inspect it in" (9:77).

Quality can be measured. Measuring quality includes tracking the costs of actions taken to assure quality alongside the costs associated with quality failures. Quality trends can be graphed on a control chart or sources of variability identified with a range chart. Since quality can be measured, the next logical area to explore and define is the primary medium through which quality is measured and managed: the quality assurance program.

What is a Quality Assurance Program?

According to Juran, a Quality Assurance Program is one that ". . . provides early warnings about production process activities that enable preventive actions to be taken prior to disastrous quality problems" (14:D-2). A quality assurance program, however, cannot be described as though it was a recipe in a cookbook. Unlike recipes, where if you follow the directions precisely, the final results will be basically identical, quality assurance program results vary; largely because of the heavy reliance on the human element. This human element comes into play at several stages. There are people who decide to implement and are responsible for

the program, people who teach the concepts and techniques, people who actually use the techniques in their daily activities, and people (including customers) who actually judge the quality of the resultant product or service. The high degree of human involvement with varying motivations, opinions, skills, and abilities is the reason a solid quality assurance program is so vital. Juran postulated that, "the fallibility of human beings is the major reason for the growth of quality assurance and its application across many quality related activities" (14:F-11). Feigenbaum presented a completed picture with his view that a quality assurance program guides the coordinated actions of not only people, but also machines and information to achieve the goal of genuine effectiveness. He added that quality programs must be recognized as a ". . . systematic group of quality disciplines that are applied on a coordinated basis by all functions throughout the entire organization" (9:11,150).

Length of Time Required to Implement a Successful Program

Instituting a successful quality program within an organization is not a rapid process. Crosby expressed that in his experience "it takes four to five years to get people to understand the need for and learn to have confidence in an improvement program" (4:10). He also argued that for

effective quality management to be practical and achievable, "it must start at the top and requires unblinking dedication, patience, and time" (4:22).

Deming agreed in principle to Crosby's ideas. He asserted that it may take longer, anywhere from three to ten years to fully integrate a quality assurance program, but he concurred the biggest problem was getting management involved (5:60). He emphasized that until top management established a constancy of purpose, the efforts of any quality assurance program would be transitory at best (5:62). Appendices A, B, and C enumerate several related suggestions that management consider in order to successfully implement a quality assurance program.

The large degree of human involvement in production and maintenance activities has another profound influence not only on the success or failure of a quality assurance program but also the length of time required for full implementation. Inevitably, the institution of a new or improved quality assurance program will lead to some minor and possibly some major changes. Changes may be instituted in training, work procedures, organizational structure, individual employee responsibilities, physical location, or even work force makeup. "Change is rarely accomplished without some degree of difficulty and resistance" (22:31). To form a successful quality assurance program, resistance

to change must be dealt with in a manner that stimulates participation and a willingness to change instead of resistance. "After all, resistance to change is a normal human reaction and much time may have to be invested in tactful diplomacy to overcome the resistance" (8:166). With the natural tendencies to resist change present, the number of years required to achieve full implementation understood, and management commitment from the top down, the next logical question to ask might be, "where should one start to implement a successful program?".

Where to Start?

It is the collection of individual workers who make up an organization that most directly affect the outgoing quality. For this reason, Collins suggested the starting point be management's belief in the value of the individual worker (3:81). This assertion implied that if management does not hold this value high, implementing a fully successful quality assurance program would be extremely difficult or even impossible.

Enrick discussed an effective method for achieving participation from the workforce - the quality circle.

> The realization that important gains in quality, productivity, and cost savings can be achieved from motivated worker participation in the decision process is of American origin. This motivative-participative approach is best when used in the form of a quality circle. This process has each part of an organization

> group together workers and supervisors in a 'circle' to review problems related to quality, cost, productivity, and safety with the goal of jointly seeking an effective solution. (8:329)

Ealey concurred with Enrick's appraisal and added that "the power of collective effort can create an extraordinarily efficient enterprise" (7:32). Finally, Landon and Moulton noted that "management must first recognize that their most valuable resource is their people" (16:23).

In the article "Quality - the Bottom Line", Wagel and others further supported the value of the worker argument. They quoted John Tosh, founder of the Tosh Management Consultants, as saying "there is almost a perfect correlation between employee's perceptions of an organization's human resources policies and the customer's perception of quality" (22:32). The strength of this correlation demonstrated a strong link between the degree of quality and the way management values and treats the workforce.

Fiegenbaum suggests that if a quality assurance program is to obtain total commitment to quality from individual workers in the company, three fundamental areas must be addressed: attitude, knowledge, and skills. He proposed programs to help develop these areas. His programs ranged from planned activities for maximizing job exposure and experience, to formalized classroom situations and organized

employee participation in quality problem solving and troubleshooting (9:201).

Juran warned that before holding a worker responsible for quality work, management must create the conditions under which it is possible for the worker to perform high quality work. Juran said that "the worker must be provided with the knowledge of what is supposed to be done, the means to know what is being done, and the power to regulate the process" (14:F-15). Many authors agreed that the success of a program required involvement from the top and acceptance throughout the organization. If these two important aspects were present, the question of where to focus improvement efforts should follow.

Where to Focus Improvement Efforts?

Many experts expressed the belief that the 'process' should be the focal point of quality improvement actions rather than the actual product or service itself. Deming, the foremost spokesman in this regard, asserted that "process improvements can yield reduced rework and mistakes, reduced wastes of manpower, machine time, and materials, and will increase output with less effort" (5:1).

Coplan paralleled Deming's thoughts on process importance by observing that beyond the identification and correction of poor quality products, there is a more

compelling need to determine the root causes of the failure and to take the necessary steps to mend the process that allowed the defect to occur (1:44). This endeavor should prevent the defect from recurring but requires a more thorough analysis than mere inspection and correction or condemnation. Juran added a precursor to this argument by insisting "the most basic quality need for the process is that it be 'capable' of making a product to the proper quality levels" (14:F-4). "But workers alone cannot change processes. Instead, it takes management to change processes because it is they who have the needed authority to make the change" (17:17).

No discussion of where to place the emphasis when instituting quality changes would be complete without a presentation of the Pareto Principle. The Pareto Principle reminds us that "where there are many items in a closed system, a few will vary the most and those few are the ones that require the identification and correction" (18:312). Pareto's principle underscores the significance of finding the few processes that cause the majority of quality problems and striving to correct them first. Following this procedure through a small number of iterations should result in substantial improvements.

A quality assurance program guides all organizational activities toward the goal of genuine effectiveness.

Acknowledging the resistance to change, implementation of a successful program may take as many as ten years. To be successful, many authors agreed that the program must have top management involved and be accepted throughout the rank and file of the workforce. These steps accomplished, the quality program should focus not on products or services themselves, but instead should focus on the processes through which they were produced. Pareto's Principle holds that the first process selected for change should be one of the few that causes the most problems. The next section overviews two case studies where new quality assurance programs have been instituted and highlights the potential benefits the programs offer (6:80-88).

Case Study #1 The Whistler Co.

The first case study analyzed the Whistler company, a subsidiary of Dynatech, a Burlington, Massachusetts based conglomerate. Whistler, one of the largest retail sellers of radar detectors in the United States, was recently experiencing a significant quality problem. The problems surfaced when a sharp growth in demand was followed by production runs that resulted in a 25 percent failure rate for first pass inspections. The company had 250 production workers, but more than half that number were being used to repair defective units. At one point, the company had

accumulated over $2 million worth of stock in defective parts. The situation was so bleak, plans were discussed for closing the plant and shifting production responsibility overseas (6:80,84).

To remedy the quality problems and ensure the survival of the U.S. plant, Dynatech instituted a quality assurance program that made several changes. The actions taken ranged from redefining every job and thoroughly training employees to installing carpeting in the reception area to add professional appearances to the place of work. The most controversial step taken was the elimination of the quality acceptance department. This step was taken to make quality everyone's responsibility, not something that can be relegated to another person or department (6:84).

After taking these initiatives, Whistler saw excellent results. The failure rates dropped from 25 percent to one percent and further improvements are still expected. Productivity increased as evidenced by the fact that output has stayed constant with an over 50 percent reduction in the labor force. Also, the overall cost structure is more in line with the competition's. These benefits actually saved the Whistler plant from being closed (6:84).

Case Study #2 The Corning Glass Works

The second case study analyzed the Corning Glass Work's television glass factory in State College, Pennsylvania. Corning's operations are heavily industrialized where raw materials are transformed into front panels and tubes for varying sizes of televisions by large furnaces, mechanical devices, and rotating molds. Corning's most persistent problem was a single bubble no larger than 20 thousandths of an inch wide which could ruin a 40 pound television panel. These bubbles were causing Corning to experience a four percent return rate from customers before implementation of a Corning quality program (6:85).

The major component to Corning's quality improvement program was the installation of inspection activities at each stage of the process instead of the old method of simply inspecting the completed units. In Corning's case the inspections included examination under bright fluorescent lights after casted panels cooled sufficiently. The increase in quality resulting from earlier detection and process improvement reduced customer returns from 4 to less than 1 percent, increased plant capacity by 40 percent and allowed for the addition of 150 hourly workers (6:85).

The overview of these two cases demonstrates actual examples of how quality initiatives like process inspection, valuing each worker, and making quality everybody's business

can effect an organization's effectiveness. In Corning's case it meant improved productivity and fewer failures, while in Whistler's case it also meant survival. The next section turns the focus from general quality improvement programs to QP-4 and describes what QP-4 is and how it works.

QP-4: What is it?

The title QP-4 was derived from the initials Q for quality, and the four Ps for the interdependent components of quality: People, Process, Performance, and Product. The Robins Air Logistics Center Quality Programs office compiled a list of eight items that identify what QP-4 is designed to accomplish. They are as follows:

1. Process Improvement: A way to apply the knowledge and experience of the workforce to improve the way things are done.

2. Customer Satisfaction: An emphasis on meeting the expectations of the customers.

3. Doing More With Less: AFLC's response to DoD's challenge to accomplish the mission effectively while facing budget cuts.

4. Participative Management: A management philosophy that recognizes the individual worth of workers and solicits their input.

5. Statistical Process Control: Applying statistical tools and techniques to analyze the systems where we work.

6. Job Security: Ensuring the capability to deliver the desired level of quality in product or service in a competitive environment.

7. Team Concepts: Working as a team to achieve common goals.

8. Increased National Defense: Instilling quality in our basic processes and workforce to ensure responsive and productive logistics support. (23:3)

With an understanding of what QP-4 was intended to accomplish, the following section describes the process under which QP-4 operates.

QP-4: How Does it Work?

The process a typical QP-4 program follows is described below:

1. Identify processes needing improvement.

2. Assign process owner for each process.

3. Assign Process Action Team (PAT) members including internal and external customers and workers.

4. Select a technical advisor or facilitator.

5. Train the owner and the team members in:
   a. Problem solving.
   b. Interaction skills.
   c. Statistical Process Control.
   d. Data Collection.
   e. Data display techniques.

6. Establish PAT meeting frequency.

7. To begin the process analysis:
   a. Define the process.
   b. Flow chart the process.
   c. Identify customers and their needs.
   d. Identify and prioritize key pulse points.
   e. Collect data and measure performance.
   f. Determine cause and effect relationships.
   g. Verify cause and effect relationships.
   h. Make changes to improve manpower, methods, material, machines, environment, etc.
   i. Document the improved process.

j. Control the process (use statistical process control charts)(23:4).

Chapter Summary

This chapter established a background of knowledge on quality issues that lay the groundwork for making recommendations for implementing AFLC's QP-4 program in an Air Force base level aircraft maintenance organization. This chapter also pointed out how there is an abundance of publications based on fundamental principles espoused by Deming, Juran, and Crosby. The chapter closed with an examination of two case studies demonstrating the benefits of actual quality programs in industry and an explanation of what QP-4 is and how it works. The benefits achieved in the presented case studies along with the simplicity and versatility found in the QP-4 PAT team process combine for a strong justification to follow through with the implementation of QP-4 in base level aircraft maintenance organizations. The next chapter maps the process undertaken to determine the best manner to initiate the implementation recommendations.

III. Methodology

This chapter outlines the steps taken to answer each specific investigative question listed in Chapter One. It further presents a brief rationale behind the selection of each question. This rationale delineates the logical progression from understanding quality, QP-4, and current training curriculum to making recommendations for implementing QP-4 in the Air Force's base level aircraft maintenance activities.

Question 1. How thoroughly does the Air Force train its incoming maintenance officers in quality improvement techniques?

As Deming emphasizes in his 14 points for management, in order to successfully implement and maintain any quality improvement program, the managers responsible for it must be trained, knowledgeable, and skilled in the program's use. The first investigative question and its subparts determined what kind, how much, and the adequacy of 'quality assurance program' training the Air Force was providing incoming maintenance officers in the Aircraft Maintenance Officers Course (AMOC). The course supervisor of the AMOC, Captain Gussie, was contacted by telephone and asked three questions.

1. What were the current course objectives relating to quality?

2. How were the course objectives determined?

3. Were there any existing plans to change the current course objectives concerning quality? (10)

Captain Dan Struble provided a copy of AMOC's course objectives which he obtained from Captain Gussie at Chanute AFB. A review of these course objectives was made to determine how many objectives of the structured curriculum dealt with quality assurance issues. The number of quality assurance related objectives, compared to the total number of objectives, should demonstrate the relative emphasis of quality assurance issues in the course as a whole.

Question 2. How can QP-4 be implemented to improve quality in base level aircraft maintenance?

Current levels of expert understanding were needed to build a solid foundation for the analysis and application of the QP-4 program to the base level. This foundation originated with current scholarly definitions of quality and methods to measure quality. To investigate these definitions and methods, a literature review was conducted of relevant books, periodicals, and journal articles from local libraries, and material disseminated by the office of the Air Force Logistics Command Commander.

The information gathered in the literature review was examined to extract similarities, identify significant differences, and make comparisons of the various ideas concerning quality. Whenever beliefs, definitions, opinions, or observations corresponded with one another, they were given increased credence for validity. This examination led to the identification of a generic set of premises that collectively provided a complete picture of what quality is, how it can be measured, and what comprises a quality assurance program. Once operating from an informed position on these quality related topics, the next reasonable step was to find out how a quality assurance program, and specifically QP-4, can be expected to perform to help the Air Force of tommorrow meet the financial challenges and expanding mission requirements it faces.

To accomplish this step, it was critical to first demonstrate that quality assurance programs have been used in the past to meet the similar challenges. To begin, an examination was conducted that considered actual results for historical industrial implementations of a quality improvement program. Two concise case studies illustrated actual results in industrial settings. These case studies provided a realistic approximation of potential advantages like improved productivity, increased reliability, and

reduced costs that a quality assurance program could bring to the Air Force.

Second, to determine specifically what a quality assurance program like QP-4 might accomplish for Air Force logistics activities, results were evaluated from five QP-4 applications in the AFLC. These five examples were selected from a larger collection of QP-4 success stories that were submitted to AFLC headquarters because of their close approximation of similar activities in a typical base level organization. After establishing the two facts that real financial benefits were achievable and that QP-4 offered tremendous potential to do so, the final step was to describe exactly how to implement QP-4 to improve quality at base level aircraft maintenance units.

A description of how to implement QP-4 required an examination of a functioning, successful QP-4 program. The Air Force Logistics Command's Air Logistics Center at Warner Robins developed and successfully implemented a QP-4 program for their depot level logistics operations. Literature on the Warner Robins program goals, structure, and strategy was showcased at an AFLC Productivity Week display at Wright Patterson AFB and was selected as a model for this study. Although other Air Logistics Centers (ALCs) are developing their own QP-4 programs, the headquarter directions and guidance for all programs is common and the Robins ALC

program was chosen based on its success, advanced degree of development, and availability of information. The Robins ALC quality offices published several pieces of literature which outlined the basic tenets of QP-4 and detailed procedures for its implementation. Their publications provided the basis for describing a useable program and were used as a reference to establish a tailored set of practical recommendations for implementation within the base level aircraft maintenance community.

Organizational responsibilities and structure, training techniques, timetables, and subject areas from both the Robins program and the findings from the literature review were used to form the recommendations for adapting QP-4 for base level implementation and ammending the AMOC quality curriculum.

In researching the investigative questions in this manner, answers were derived by comparing and contrasting expert definitions and opinions, synthesizing related approaches, critically evaluating the existing AMOC curriculum, and extracting procedures that apply to an industrial environment such as aircraft maintenance. The details of examinations of the five successful QP-4 applications in logistics environments common to depot and base level aircraft maintenance organizations and the

current curriculum on quality in the AMOC are presented in the next chapter.

IV. Examination of Successful QP-4 Applications, QP-4 Format, and Current AMOC Quality Curriculum

This chapter contains the findings from an analysis of information orignating from three primary areas. First, the versatility and potential rewards for implementing a QP-4 program will be exemplified by reviewing five different QP-4 applications within the AFLC. Second, the format of the QP-4 program being implemented at the Robins Air Logistics Center (ALC) will be presented. The final area discussed will be the degree to which the Air Force's aircraft maintenance officer's course covers quality assurance program topics. The facts observed while analyzing these three areas, in addition to the knowledge gained through the literature review, result in the recommended implementation plan for QP-4 in base level aircraft maintenance organizations found in Chapter V.

QP-4: Five Examples of Actual AFLC Applications

The QP-4 program, centered on the actions of a Process Action Team (PAT) has two primary strengths: simplicity and a structure that can easily apply to a wide range of quality issues. The following five examples demonstrate the simplicity, versatility, and effectiveness of instituting a QP-4 program.

The Aircraft Guidance and Metrology Center (AGMC) was recently experiencing problems with their Mission Capable (MICAP) parts processing operations. The number of customer call-ins requesting status updates, which required tracking information from various sections in the center, was consuming excessive time and interrupting the work flow of the center. The process was identified for PAT attention and a PAT was organized and assigned to the problem. The PAT decided the best manner to handle the problem was to establish a separate customer service unit and consolidate the information from many sources into one. The implementation of this recommendation resulted in a significant decrease in the time required to process the requests. The time is now measured in hours instead of days and the information transfer is smoother and more accurate. QP-4 did not provide a magical answer to AGMC's dilemma, but instead provided a structured forum for the people affected by the problem to develop a solution.

The Oklahoma City ALC had information accuracy problems in their Maintenance Inventory Control (MIC) unit. The measured accuracy rate was typically only 50 percent. Members of the assigned PAT analyzed the low accuracy rate and decided to subdivide the MIC into six specialized, smaller units from one large unit. Serving the various engine production lines from the six unit configuration used

the same people and space but provided better accountability and more specific knowledge. The result was a dramatic improvement in the accuracy rate to 95 percent.

At the San Antonio ALC, the F100 engine section was experiencing problems with unusually high failure of the #4 Bearing Scavenge Tube. These tubes needed replacement at a significantly higher rate than was expected. The high consumption resulted in dangerous decreases in the available supply levels and was threatening to cause a costly work stoppage. A PAT assigned to the problem determined many actions were required. First, development and production of new fixtures for the tube were needed to overcome the immediate shortage. Second, overly stringent technical order requirements on safety wiring procedures needed relaxation to prevent unnecessary removal actions. Third, a special tool was needed to replace one currently in use that was inadvertently causing damage to units when used. Implementing these PAT recommendations resulted in a 60 percent reduction in removal rates and a cost savings in excess of $164,000 in the first year alone.

The ALC in Sacramento encountered large excesses in due-in supply items which exceeded $2.5 million in value. The ALC needed a plan to reduce the current levels of excess and to preclude the recurrence of similar excesses in the future. A PAT recommended a written plan that called for

monthly examination of due-in levels and follow-ups when levels exceeded given thresholds. In the follow-ups, continuing needs were either validated or cancelled to insure only genuine requirements were maintained. The plan cut the current excesses by over 80 percent and promised to hold future levels to a minimum.

These five examples demonstrate the value and diversity of QP-4 and the Process Action Team concept. By grouping workers and customers together from areas affected by a problem and structuring their collaboration, seemingly complex or insurmountable difficulties can be broken down and overcome to the satisfaction of all concerned. The QP-4 program can provide the Air Force with effective processes which are more efficient and improve the quality of the outputs. The following section will showcase the outline of the QP-4 program being implemented in the Robins ALC to examine how a typical QP-4 program would be constructed for depot level logistics activities.

QP-4 at the Robins ALC

QP-4 at the Robins ALC is a multi-faceted program in use throughout the Directorate of Maintenance to ensure depot level logistics activities are continuously improved. By analyzing the specific program content and format, further insight is provided to make recommendations for

subsequent implementation of a similar program for base level aircraft maintenance functions.

The program at Robins included an education plan consisting of 12 different courses which were designed for combinations of 15 executives, 325 managers, 400 PAT members, 40 PAT leaders or facilitators, and over 6500 workers. The overall training plan forecasts the completion of initial classes through 1991 with the ultimate goal of involving every last person in the process of controlling, measuring, and continuously improving the center's quality efforts.

The primary goal of the courses is simple: to prepare the students for their role in the overall QP-4 program (21:2). In order to accomplish this goal, the courses start with the fundamentals of quality based primarily on Deming's philosophies concerning process improvement. The courses also provide instruction to students in the use of statistical and graphical tools, along with computer software, that are all useful for implementing the techniques associated with process improvement efforts. In the first year of implementation, over 20,000 hours of instruction were provided.

The Robins ALC program recognized the importance of determining individual differences between people so that the program can be best tailored to suit the varying needs.

To better understand these individual differences, the tool in use is the Personal Profile System questionnaire copyrighted by Performax Systems International, Inc.

The underlying process used throughout the program is the scientific problem solving method. This method included the following steps: process identification, prioritization, training team members, collecting data, identifying pulse points or key indicators, statistical process control analysis, controlling, improving, and monitoring. The training in statistical process control analysis included pareto charts, flow diagrams, cause and effect diagrams, graphical displays, experimental design, and the use of control charts. Each course was tailored to the needs of the students involved. For example, the courses for the executives did not concentrate on the manipulation of formulas or the construction of complex graphs. Instead, the executive's courses focused on understanding the information, drawing appropriate conclusions, and simplifying the decision making process.

The primary vehicle for making quality improvements in the Robins ALC program was the Process Action Team (PAT). These teams were formally assigned by management to make process improvements and were disbanded upon job completion. The PATs were assisted by 'facilitators' who support, guide, coordinate, and control the actions of the team. Again,

specific courses were provided for both individuals who assume the important roles of PAT member and facilitator.

The WR-ALC was committed to improving the quality and efficiency of all processes undertaken at the center. Their QP-4 program's focus was continuous process improvement and the primary instrument for making those improvements was the Process Action Team. These teams were structured and trained to use the scientific method for problem solving and supplement this method with statistics, graphics, and computer assistance. The program highlighted the need for every individual to be involved and thoroughly trained in the characteristics of quality improvement as they apply to their role in the organization and the QP-4 program. Having described a typical structure of a QP-4 program, the next section examines the training provided to the future managers of just such a program at the base level.

Quality Training For Aircraft Maintenance Officers

Aircraft maintenance officers have a direct influence on the level of quality that exists in base level maintenance activities. As Officer-in-Charge (OIC) of a branch or Maintenance Supervisor for a squadron, the maintenance officer makes daily decisions that affect the quality of his duty section's output. He selects the amount and type of training to be conducted and communicates both

verbally and by example the quality objectives of the organization. Through his involvement in the work effort, he contributes to the motivation and development of the workforce so that they are willing and able to support the stated quality objectives. To direct the quality mission of an organization, the maintenance officer must at least possess a basic understanding of what quality is and how it can be improved. For this reason, the Aircraft Maintenance Officer's Course (AMOC) was examined to determine if this course provided that basic understanding.

An interesting finding was made with regard to the 'quality' material included in the list of AMOC course objectives. The only course objective related to quality or quality assurance was the objective to correctly identify the responsibilities of the quality assurance division (QAP), a staff agency directly under the Deputy Commander for Maintenance (DCM). The list of responsibilities covered in this course objective came from three areas: The objectives of QAP, the objectives of inspections, and the specific functions of QAP personnel (19:1).

By focussing the students' attention on the objectives and functions of QAP, the AMOC is missing the opportunity to highlight one of the ten commandments of a successful quality assurance program. That commandment states that quality is <u>everyone's</u> responsibility and it cannot be

delegated to another person or an individual division (Appendix C). In addition, commitment to quality must come from the top and be embedded in all sections of the organization in order to meet overall quality objectives (Appendix A and B). To be sure, the AMOC does not present QAP as the sole gaurdians of quality, but no structured portion of the course curriculum identifies the critical role and responsibilities that the maintenance officer is about to be called upon to perform as part of the quality effort. The course also does not present any of the historically significant expert scholar's strategies and philosophies for quality. Any coverage of these topics would have to come informally, through classmate or instructor experience in an unstructured discussion. In this respect, the AMOC does little to adequately prepare the maintenance officer for his role in the organization's quality efforts.

The course objectives used in the AMOC were built from requests from the operational commands. The course supervisor receives the requests and assimilates the topics into the course material. The thrust of the current command requests, and therefore the course material, is to teach the maintenance officer basic aircraft system operation and vocabulary, maintenance organization structure and function,

management skills, and general preparation for work in the aircraft maintenance community (10:1-3).

Chapter Summary

This chapter revealed three relevant findings. First, QP-4 has already been demonstrated as a means for tremendous process improvements and cost savings in various AFLC logistics applications. Second, the WR-ALC built a solid foundation for a successful QP-4 program based on time-tested, expert beliefs on quality and was committed to continually making process improvements for all its organizations. Third, the AMOC was not currently being utilized to initiate the education process for aircraft maintenance officers with regard to developing their understanding of important quality improvement topics. The next chapter presents four pivotal conclusions drawn from the entirety of this study and recommends a method for implementing the QP-4 program in base level aircraft maintenance operations.

V. Conclusions and Recommended Implementation Plan

This chapter takes the general knowlege already examined concerning Air Force aircraft maintenance operations, quality, and the QP-4 program and draws reasonable conclusions about the significant interdependance between the three areas. From these conclusions, follows a step by step implementation plan calling for actions at both the Air Force and base levels. These actions will incorporate the lessons demonstrated in this study into field practice. Following these two major sections, the chapter will close with a presentation of related research areas that offer potential for further benefits to the Air Force. In this manner, Chapter V reflects the culmination, transforming a search for quality understanding and case analysis into a set of logical, valuable, and systematic actions for Air Force managers' implementation.

Conclusions

First and foremost, General Hansen's desciption of the strained financial future of the DoD as a result of the Gramm Rudmann Hollings Act and General Gillis' observations concerning the expanding maintenance mission requirements facing the Air Force of tommorrow give a compelling impetus for proactive action. Whatever actions are eventually

taken, they should compensate for a financial environment that appears to be making a significant reversal in direction from the days of ample funding to a future of austere financial constraints. The actions should also take into account the aging fleet of aircraft, which will necessitate increasing amounts of support in terms of repairs, spare parts, money, and people. These decreasing budgets and expanding logistics requirements create an important need to derive as much value possible from every last unit of input available to aircraft maintenance managers for projected mission requirements to be even minimally achieved. This realization led directly to the next conclusion.

Second, the Whistler and Corning case studies were two typical examples that showed how improving quality offers an excellent avenue for making a successful transition to these challenging times. Improving quality in these two cases was clearly shown to be an effective means for increasing the returns on investment and performance measurements of organizations in the private sector and, therefore, was at the very least worth exploring for applicability in an Air Force logistics environment.

Chapter 4 depicted the QP-4 quality assurance program as a versatile and effective program for an AFLC Air Logistics Center. It also presented an examination of many

features of the QP-4 program in place at the Robins ALC. The simplicity and versatility it possessed also gave it strong potential for use in similar military organizations such as base level aircraft maintenance agencies. Following this logic, the third conclusion was made that aircraft maintenance at the wing level should also increase their return on limited resources from an improvement in quality through the implementation of a QP-4 program.

The fourth conclusion stemmed from the recognition that the primary vehicle through which quality is attained, maintained, improved, and otherwise managed was the quality assurance program. Both Deming and Crosby, in their respective fourteen points for management, emphasize the fact that to 'administer' or manage a successful quality assurance program, the people responsible for its success must be committed, trained, and knowledgeable in quality philosophies, strategies, fundamentals, and techniques. Based on this realization, the Aircraft Maintenance Officer's Course (AMOC) curriculum was analyzed. The conclusion was reached that the AMOC is not laying an appropriate foundation of quality improvement skills for incoming aircraft maintenance officers and changes should be incorporated in the curriculum to accomplish this goal. The following section of this chapter will outline the specific recommendations for action that will:

a) implement QP-4 in base level organizations and,

b) transform the AMOC so that it produces aircraft maintenance officers who are prepared to manage and improve the quality assurance effort in their subsequent duty locations.

Recommended Implementation Plan

The following three phased implementation plan should make the transition to full scale use of QP-4 both smooth and successful.

Phase 1: Introduce and Publicize. One of Deming's and Crosby's top priorities for implementing a successful quality assurance program is management commitment or constancy of purpose (21:68,74). To make QP-4 a useable and functioning tool in wing level aircraft maintenance organizations, that commitment or constancy of purpose must come from the top - the Deputy Commander for Maintenance (DCM). The effort to gain this support should be handled in an educated and mature fashion. If QP-4 was implemented purely as a directive, it, like so many other directives, would fall to the wayside and become a subject of only minimal effort and verbal dedication. If on the other hand, DCMs, squadron commanders, and other key maintenance managers were involved in the implementation process, the likelihood for enthusiastic support and effective use would be greatly enhanced. To introduce and publicize QP-4 to

these key maintenance managers, a systematic approach should be taken.

First, the various Air Force headquarters and major commands should facilitate the introduction, publication, and education processes involved in making the QP-4 implementation a success. They should fund further research, sponsor TDYs for key managers at both the wing and headquarters levels, and organize conferences for key managers to gather and share experiences, philosophies, strategies, and lessons learned. The major commands should also take such actions as to publicize the benefits attained at the various wings and reward all successful wings with meaningful recognition.

Second, the headquarters and major commands should go even further to promote the QP-4 program and increase effectiveness in base level organizations. These staff level organizations determine, by way of inspection team guidance, the direction of operational unit's management action. For example, if inspection teams judge the wing's performance by inspecting finished products, the local QA programs and squadron supervision's efforts will rest predominantly in that area. This is the case under the current system, where managers are faced with the knowledge that their performance will be judged on the quality of finished goods like aircraft or support equipment.

Accordingly, a disproportionate amount of time and effort is spent ensuring that the products the inspector will likely inspect meet or exceed the standard. This philosophy treats the symptoms rather than the causes and in effect, wastes valuable resources. If, on the other hand, the basis of the wing's performance was evaluated based on the processes involved in producing the finished good, the focus of management attention will turn to those processes. This simple change of approach will go a long way towards matching the performance measurements to the central concept of Process Action Teams and the QP-4 program. It focuses on causes rather than symptoms and in doing so, should improve how the personnel are trained, how they actually perform their jobs, and possibly the processes themselves.

After this refocussing has taken place, it may still be necessary to persuade, through reason, key maintenance managers, who are familiar and comfortable with the traditional practices, that QP-4 and its philosophies should be embraced and implemented. To enlist the enthusiastic support and commitment of key maintenance managers, the following four step process is recommended:

Step 1. First, the key leaders should be shown a detailed projection of what to expect in the way of future maintenance requirements for the current, aging fleet of Air Force weapon systems.

Step 2. Following this demonstration, the group should see an extrapolation of the diminishing resources they will have at their disposal to meet those requirements and the expected results in terms of decreased performance capabilities.

Step 3. After witnessing the magnitude of this rather bleak scenario, the key managers should be given a presentation of potential applications and benefits for implementing QP-4 as a tool for improving quality and battling the impending dilemma they will eventually face. This systematic approach should convince the key managers that using QP-4 is a logical alternative for their specific situation.

Step 4. Finally, the key managers should be solicited for their ideas on how to best implement this quality improvement method. Issues or questions this group would be able to help clarify may include: What is the best structure for a QP-4 hierarchy in a base level unit? Which QP-4 training courses could best be taught at a base level unit? How many pilot programs should be used as a first step in the implementation process?

Education, benefit demonstration, and involvement of the key maintenance managers in this manner should make the implementation and use of QP-4 smoother and quicker. This sequential, reasonable persuasion approach should also

result in a program that is an effectively used way of life for wing level maintenance activities well into the future. With Phase 1's successful completion, current managers should be committed to the QP-4 process. It follows that incoming maintenance officers should be afforded similar enlightenment so that the knowledge and commitment are carried forward throughout future changes in personnel. The following section reveals the next phase in the plan to implement QP-4 in base level aircraft maintenance organizations.

Phase 2: Ongoing Training and Education. In keeping with Crosby's and Deming's high priority for training and educating the people responsible for the success of a quality assurance program, aircraft maintenance officers should be trained and knowledgeable in a wide range of quality areas. To attain the needed level of skill in the base level aircraft maintenance squadrons, the Aircraft Maintenance Officer's Course (AMOC) should include several quality assurance topics in their curriculum for incoming aircraft maintenance officers. The normal manner to generate this inclusion is for the operational commands to request the topic's coverage to the AMOC course supervisor. The need for this action should become apparent to the operational commanders after their key maintenance managers

are involved in the QP-4 introduction and publication phase as discussed in the preceding paragraphs. Therefore, the operational commanders should make formal requests to the AMOC course director for inclusion to AMOC curriculum of quality improvement philosophies, strategies, and methods.

Similar to the key managers, the students' appreciation for the value and importance of quality management must be gained from the outset. There is probably no better way for the course to earn the student's respect for quality than to drive home the fact that they, even as young maintenance officers, will be making important decisions and setting far-reaching section policies with quality decisions. Their actions will affect the quality of work on multi-million dollar aircraft that may result in lives being either saved or lost and hundreds of thousands or even millions of dollars worth of equipment being either used effectively or wasted. With a student who is motivated by real world concerns to learn a particular craft or skill, the chances of the student absorbing and retaining the needed information for successful quality management will be greatly improved. Once operating in this environment, the direction of the course should focus on: the particulars of what quality means as it applies to aircraft maintenance, how quality is achieved, improved, and otherwise managed, and how best to put into practice the principles and

techniques to which the student will be exposed. The following section describes a collection of changes to the AMOC curriculum that should be regarded as minimum changes for an initial improvement iteration.

As a minimum, there are several basic areas of study that should be incorporated into the AMOC as a means for the long term perpetuation of the recommended QP-4 implementation. Many of these recommendations reflect the inclusion of critical subject areas found throughout the multitude of QP-4 courses in place within the Robins ALC QP-4 education plan.

The curriculum should be expanded to include a background of quality definitions and philosophies from renowned experts in the field such as Juran, Crosby, and Deming. These scholars' ideas will set the stage for the students so that they will gain an appreciation for the meaning of quality and be able to apply basic quality analysis to the environment they will soon encounter.

The curriculum's next logical alteration would be in the area of the base level quality assurance program. Under this topic area, only cursory emphasis should be placed on the role of actual Quality Assurance personnel; instead, the bulk of the attention should be concentrated on the maintenance officer's role in the overall quality effort. At all times, the curriculum should amplify the point that a

fully successful quality assurance program requires everyone's involvement and that at no time can the responsibility be delegated or left to a particular person or set of people.

Another area of primary importance that should be stressed in the quality portions of the course is the focus on improving the process over inspecting the product. Deming taught that by focussing on inspecting products, the realm of influence is limited to those products examined. By improving a process, the program improves an entire body of products that flow from that process. Though the point may seem intuitive, all too often it is overlooked and valuable time and effort is ill spent.

One final area that bears inclusion in the minimum AMOC curriculum changes is an introduction to the QP-4 program. QP-4 is no magical formula or mysterious process that should be kept a guarded secret or billed as a difficult-to-learn procedure. Instead, it is simply a structured method for employing the time proven technique of 'scientific problem solving'. QP-4's major benefit is its simplicity, but caution should be given for taking the simplicity for granted. There may be instances where complicated statistical tools and mathematical formulae are necessary, but by and large the problem being dealt with will drive this degree of difficulty. Many of the applications will

require little, if any, of these advanced skills. Instead, a basic understanding of statistics, along with the skills to graph processes, use Pareto analysis, value analysis, and flow chart simple cause and effect diagrams should be all that's required to initially prepare the young maintenance officers for their first tour in an aircraft maintenance squadron. In general, QP-4 puts together the knowledgeable people involved in the process requiring change, and structures their effort toward finding practical solutions for process improvement through logical step by step procedures using whatever tools are applicable to the specific problem encountered. To make the maintenance officers more effective, they should be introduced to the QP-4 process at this time.

As Dreyfuss pointed out in his Ten Commandments of Quality, "Quality is everybody's business" (6:85). For this reason, a logical outgrowth to training incoming aircraft maintenance officers in the use of QP-4 and other basic quality improvement methods would be to include such training for other personnel in maintenance as well. There is no reason this effort would have to be limited to the officer corps alone, it could also be incorporated into courses for Non-Commissioned Officer's (NCOs) and airmen. As a matter of fact, there should be enough value in the QP-4 courses to merit their inclusion, or at least

introduction, in training material for several related career fields such as supply, transportation, or even administration. Taking a systems approach, all organizations in the base level community can begin working together to create the most effective processes possible. With large numbers of agencies being educated and involved in quality solutions, maximum benefits can be derived for all concerned. The next section will deal specifically with the implementation of QP-4 in the base level aircraft maintenance organizations.

Phase 3: Implementation of QP-4. Once the top management is introduced, educated and committed, and maintenance officers are trained in the described manner, base level aircraft maintenance organizations can begin to put QP-4 and the PAT concept into practice. This section will deal primarily with the structure and goals a base level unit should utilize and is based on the WR/ALC model and the thrust of Crosby's and Deming's scholarship on successful quality assurance programs.

Restating Crosby's and Deming's contention, success of a QP-4 program hinges on support and involvement from the top. To this end, the DCM or Wing Commander (if implemented wing-wide) should play a key role in locally organizing,

publicizing, and managing the QP-4 program. Each Squadron Commander or section leader must also be involved in his/her programs and be a part of the team that identifies which processes need attention, selects the appropriate members of the Process Action Team (PAT), and ensures the PAT's recommendations are fully implemented.

A QP-4 program, as defined in WR/ALC/RAFB Pamphlet 74-8, implies a simultaneous consideration of the process, person, product, and performance. This approach is important to consider in that all managers must meet the challenge of applying appropriate attention to all four of these areas. The managers must provide rewards for good performance, avenues for involvement of all workers in work, and social settings that build a cohesive team. They must also possess an understanding of worker needs and the influence of human factors on performance. They must clearly communicate specific section goals and outline a defined path and strategy to detail each person's role in the quest for major quality improvements. These actions will necessarily vary from unit to unit depending on the skills, education, and personalities of the people in each section. There is no simple recipe for managers to follow to attain an effective organization using QP-4 or any other method. This fact is the basis for the recommendation that the education process should be changed so that maintenance

managers are taught, not a prescription, but the various philosophies and interpretations so that they may fine tune their program to meet their specific needs.

The next section will present a collection of related subject areas where further research may strengthen the recommendations made herein or provide further benefit to the DoD or specifically the USAF.

Recommended Further Research

One area for future research would be to quantify the environment of the next few years for the aircraft maintenance community. The research should take into account the aging fleet of aircraft, with increasing logistical requirements, and the forecast decline in budgetary appropriations. Quantifying the resulting effects on mission performance parameters should lend further credence to the justification for increased emphasis on quality and QP-4 as a means to shore-up the declining capabilities under those projected circumstances.

Not only could research be conducted to quantify the declining capabilities under austere financial conditions, the expected benefits in reduced workload, less expensive procedures, and reduced manning requirements could also be estimated. Combining these two research efforts would make an excellent source of decision support information for

possible use at the highest of levels within the Department of Defense.

Another related area that bears investigation is the impact QP-4 has on Air Force personnel. It may be that the full scale implementation of QP-4 reduces the number of frustrating and unneeded regulations, simplifies steps in complicated procedures, and increases worker satisfaction by allowing for meaningful involvement in important decisions. These factors may in turn lead to increased retention rates, increased experience levels, and reduced training and recruiting costs. These side effects and benefits in the personnel arena offer excellent ground for useful research to determine, if in fact those sorts of human relationships exist, if the Air Force can take advantage of them, and to further justify a full scale incorporation of a DoD wide QP-4 program.

This concludes the systematic progression from research and exploration of quality and QP-4 to logical conclusions and step by step recommendations for QP-4's implementation. The final section, suggested areas for further research, should provide a starting point for those wishing to build on the study.

Appendix A: Deming's Fourteen Points For Management

1. Create Constancy of Purpose for Improvement of Products and Services.
2. Adopt the New Philosophy.
3. Cease Dependance on Mass Inspection.
4. End the Practice of Awarding Business on Price Tag Alone
5. Constantly and Forever Increase the System of Production and Service.
6. Institute Training on the Job.
7. Institute Leadership.
8. Drive Out Fear.
9. Break Down Barriers Between Staff Areas/Departments.
10. Eliminate Numerical Goals for the Workforce.
11. Eliminate Work Standards and Numerical Quotas.
12. Remove Barriers That Hinder Hourly Worker.
13. Institute a Vigorous Program of Education and Self Improvement.
14. Put Everybody in the Company to Work to Accomplish the Transformation. (21:68)

Appendix B: Crosby's Fourteen Points for Management

1. Management Commitment
2. Process Improvement Team
3. Quality Measurement
4. Cost of Quality Evaluation
5. Quality Awareness
6. Corrective Action
7. Zero Defect Planning
8. Quality Education
9. Zero Defects Day
10. Goal Setting
11. Error Cause Removal
12. Recognition
13. Quality Councils
14. Do it over again (21:74)

Appendix C: Ten Commandments of Quality

1. There is no such thing as acceptable quality. It can always get better.

2. From the corner office to the shop floor, quality is everybody's business.

3. Keep your ears open. Some of the best ideas will come from the most unexpected sources.

4. Develop a detailed implementation plan. Talking about quality isn't enough.

5. Help departments work together. The territorial imperative is your biggest obstacle.

6. Analyze jobs to identify their elements and set quality standards for each step.

7. Take control of your processes. You must know why something goes wrong.

8. Be Patient. Don't expect gains to show up next quarter.

9. Make extraordinary efforts in unusual situations. Customers will remember those best.

10. Think beyond cutting costs. The benefits of improved quality should reach every part of the organization. (6:85)

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ABSTRACT

The purpose of this study was to recommend a method for implementing QP-4, an Air Force Logistics Command Quality Assurance Program, in a base level aircraft maintenance organization. There were three objectives related to this study. The first was to provide aircraft maintenance managers with a means to identify the quality management needs in the field. Second was to familiarize maintenance managers with state-of-the-art knowledge concerning the definition of quality, how to measure it, and what comprises a quality assurance program under QP-4. The final objective was to showcase the QP-4 program currently functioning and meeting a good deal of success at the Warner Robins Air Logistics Center.

Accomplishing these objectives resulted in a plan to implement QP-4 in a base level organization so that field managers could effectively deal with projected expanding mission requirements along with reductions in resource availability due to budget limitations in a constrained financial future operating environment.

Examination of industrial case studies and results of QP-4 implementation at Warner Robins led to the conclusion that the simplicity and versatility of QP-4 would be beneficial to field managers for meeting these future challenges. The recommendations include beginning quality and QP-4 training in the Aircraft Maintenance Officers Course (AMOC) with specific topic coverage recommendations. Also recommended was the systematic implementation of QP-4 in the base organizations by using a three phased implementation plan. First introduce and publicize, then educate and train, and finally implement and structure basically in line with the program operating at Warner Robins. In closing, the study recommended areas of related research that may further support or build on this initial endeavor.